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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER		
RUDO117125		
U.S. APPLICATION NO. (if known see 37 C.F.R 1.5)		
INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	EARLIEST PRIORITY DATE CLAIMED
PCT/US99/23563	8 October 1999	14 October 1998
TITLE OF INVENTION		
TRIAXIAL WEAVE FOR REINFORCING DENTAL RESINS		
APPLICANT FOR DO/EO/US		
David N. Rudo		

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information by **Express Mail**:

__X__ 1. This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

_____ 2. This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 37 U.S.C. 371.

__X__ 3. This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.

__X__ 4. A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

__X__ 5. A copy of the International Application as filed (35 U.S.C. 371(c)(2))

_____ a. is attached hereto (required only if not communicated by the International Bureau).

_____ b. has been communicated by the International Bureau.

__X__ c. is not required, as the application was filed in the United States Receiving Office (RO/US).

_____ 6. An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).

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_____ 7. Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))

_____ a. are attached hereto (required only if not communicated by the International Bureau).

_____ b. have been communicated by the International Bureau.

_____ c. have not been made; however, the time limit for making such amendments has NOT expired.

_____ d. have not been made and will not be made.

_____ 8. An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

__X__ 9. An oath or declaration of the inventor (35 U.S.C. 371(c)(4)).

_____ 10. An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 20. below concern document(s) or information included:

_____ 11. An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98.

_____ 12. An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included.

__X__ 13. A FIRST preliminary amendment.

_____ 14. A SECOND or SUBSEQUENT preliminary amendment.

_____ 15. A substitute specification.

_____ 16. A change of power of attorney and/or address letter.

_____ 17. A computer-readable form of the sequence listing in accordance with 35 U.S.C. 1.821 – 1.825.

_____ 18. A second copy of the published international application under 35 U.S.C. 154(d)(4).

_____ 19. A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

__X__ 20. Other items or information:

__X__ a. A copy of the Amendment to the claims under PCT Article 34.

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X 21. The following fees are submitted:				**CALCULATIONS** PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5):					
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $1,000					
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.... $860					
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO..... $710					
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)..... $690					
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $100					
			ENTER APPROPRIATE BASIC FEE AMOUNT =	$690	
Surcharge of $130 for furnishing the oath or declaration later than ____ 20 ____ 30 months from the earliest claimed priority date (37 CFR 1 492(e)).				$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	26 - 20 =	6	X $18	$108	
Independent claims	2 - 3 =	0	X $80	$	
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)			+ $270	$	
			TOTAL OF ABOVE CALCULATIONS =	$798	
___X___ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.					
			SUBTOTAL =	$399	
Processing fee of $130 for furnishing the English translation later than ____ 20 ____ 30 months from the earliest claimed priority date (37 CFR 1 492(f)). +				$	
			TOTAL NATIONAL FEE =	$399	
Fee for recording the enclosed assignment (37 CFR 1.21(h)) The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3 31) $40 per property +				$	
			TOTAL FEES ENCLOSED =	$399	
				Amount to be: refunded	$
				charged	$

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X a. Check No. 127153 in the amount of $ 399.00 to cover the above fees is enclosed.

X b. The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-1740. A duplicate copy of this sheet is enclosed.

SEND ALL CORRESPONDENCE TO:

Customer No. 26389

Barry F. McGurl
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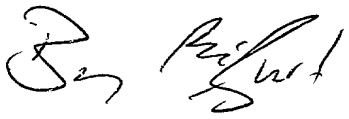
Respectfully submitted,

CHRISTENSEN O'CONNOR
JOHNSON KINDNESS[PLLC]



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EXPRESS MAIL CERTIFICATE

"Express Mail" mailing label number **EL 491231413** US
Date of Deposit **April 12, 2001**

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above and is addressed to the Commissioner for Patents, Washington, D.C. 20231.

Yvette Lovett
(Typed or printed name of person mailing paper or fee)

(Signature of person mailing paper or fee)

BFM:ctg

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: David N. Rudo Attorney Docket No.: RUDO117125

Title: TRIAXIAL WEAVE FOR REINFORCING DENTAL RESINS

PRELIMINARY AMENDMENT

Seattle, Washington 98101

April 12, 2001

TO THE COMMISSIONER FOR PATENTS:

Please enter the following Preliminary Amendment for the patent application filed herewith, which is the United States national application corresponding to International Application No. PCT/US99/23563:

In the Specification:

Amend the specification by inserting the following new section on page 1 after the title:

Cross-References to Related Applications

This is a United States national stage application of International Application No. PCT/US99/23563, filed October 8, 1999, the benefit of the filing date of which is hereby claimed under 35 U.S.C. § 120, which in turn claims the benefit of U.S. Provisional Application No. 60/104,265, filed October 14, 1998, the benefit of the filing date of which is hereby claimed under 35 U.S.C. § 119.

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REMARKS

The foregoing amendment to the specification sets forth the claim of priority made in the present application.

Respectfully submitted,

CHRISTENSEN O'CONNOR
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RUDO\17125AM DOC

VERSION WITH MARKINGS TO SHOW CHANGES MADE APRIL 12, 2001

In the Specification:

A new section entitled "Cross-References to Related Applications" has been added on page 1 after the title.

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TRIAXIAL WEAVE FOR REINFORCING DENTAL RESINS

Field of the Invention

This invention relates generally to methods for constructing, reinforcing or modifying dental restorations, dental appliances and prostheses (herein collectively referred to as "dental structures"), to dental reinforcing materials, and to reinforced dental structures. The invention also relates to the field of reinforced plastics and resins.

Background of the Invention

Dental resins are polymeric materials that are used to construct dental structures such as restorations, prostheses and appliances. They are brittle, isomeric materials that exhibit relatively poor stress-bearing properties. In order to enhance the stress-bearing properties of dental resins and to minimize crack propagation, fiber reinforcements have been incorporated within dental resins. Fiber-reinforced dental resins are anisotropic materials that derive their strength and stiffness from reinforcing fibers embedded within the resin. The orientation of the reinforcing fibers provides directionality to the properties and performance attributes of the resin. The properties and performance attributes of fiber-reinforced dental resins include, for example, the ability of the resin to resist an externally-applied shearing force.

Resins that include reinforcing fibers that are all oriented in one direction are restricted to performance in the direction of the reinforcing fibers. Thus, for example, the ability of a resin, that includes reinforcing fibers that are all oriented in one direction, to resist a shearing force applied at any angle other than along the axis of the reinforcing fibers approaches that of the unreinforced resin. Additionally, prior to curing, the resin is unstable since it can easily shear and thereby deform in a direction

that is transverse to the direction of the fibers. Thus, for example, when an uncured resin, that includes reinforcing fibers that are all oriented in one direction, is being manipulated to conform to the contours of the teeth and or the dental arch, the material has a tendency to shear and deform in a direction that is transverse to the longitudinal axis of the fibers.

One attempted solution to the problem of shear and deformation of resins, that includes reinforcing fibers that are all oriented in one direction, has been to reinforce resins with biaxial weaves which are fabrics that include reinforcing fibers oriented in two, usually orthogonal, directions. Thus, biaxial weaves are able to resist shearing in two directions. Nonetheless, in a biaxial weave individual fiber bundles or yarns can still slide past each other, thereby causing the fabric to shear and deform. Further, biaxial weaves cannot resist deformation caused by an external force applied in any direction other than the two directions in which the reinforcing fibers are oriented. Deformation and shear is a problem, for example, when the fabric is impregnated with resin to form a composite, or when the fabric is manipulated to conform to the contours of a tooth or the dental arch.

Thus, there is a need for a method of constructing, reinforcing or modifying dental structures so that they are mechanically stable and can resist external forces applied from various directions.

Summary of the Invention

The present invention provides methods for constructing, reinforcing or modifying dental structures. The methods of the present invention include the step of contacting a dental structure with resin and a triaxial material. Preferably the triaxial material is in the form of a triaxial braided or woven fabric. The resin can be any dental resin but is preferably selected from the group consisting of acrylic resin, urethane resin and methyl-methacrylate resin. The resin is most preferably bis-GMA resin. The triaxial material is preferably made from fibers selected from the group consisting of silk, nylon, polyester, polypropylene, aramid, ultra high molecular weight polyethylene, glass, boron, carbon and silicon carbide. The presently preferred aramid is Kevlar™, and the presently preferred, ultra high molecular weight polyethylene is Spectra™ which is preferably treated with gas plasma, more preferably with cold gas plasma. Representative examples of dental structures that can be treated in accordance with the methods of the present invention include, but are not limited to, the group consisting of fillings, periodontal splints, directly bonded endodontic posts, directly bonded endodontic cores, bonded orthodontic retainers,

bridges (including directly bonded bridges), over-denture structures, composite-resin restorations, and implant retained maxial facial prostheses. The triaxial material preferably includes fibers oriented in three different directions, one of which directions is the direction of the long axis of the dental structure. More preferably from about 33.3% to about 50% of the fibers are oriented in the direction of the long axis of the dental structure.

In one presently preferred embodiment, the methods of the present invention include the steps of applying at least one layer of triaxial material to a resin portion of a dental structure; infusing the triaxial material with resin, and covering at least a portion of said triaxial material (preferably all of the triaxial material) with resin. In another presently preferred embodiment, the methods of the present invention utilize successive layers of triaxial material, each of the successive layers being offset by a desired angle with respect to a preceding layer.

In another aspect, the present invention provides dental structures including a triaxial material. Preferably the triaxial material is triaxial braided fabric and/or triaxial woven fabric. The triaxial material is preferably made from fibers selected from the group consisting of silk, nylon, polyester, polypropylene, aramid, ultra high molecular weight polyethylene, glass, boron, carbon and silicon carbide. The presently preferred aramid is Kevlar™, and the presently preferred, ultra high molecular weight polyethylene is Spectra™ which is preferably gas plasma-treated Spectra™, more preferably cold gas plasma-treated Spectra™. Representative examples of dental structures, including a triaxial material, of the present invention include, but are not limited to, the group consisting of fillings, periodontal splints, directly bonded endodontic posts, directly bonded endodontic cores, bonded orthodontic retainers, bridges (including directly bonded bridges), over-denture structures, composite-resin restorations, and implant retained maxial facial prostheses.The dental structures of the present invention preferably also include at least one type of dental resin that covers at least a portion of (preferably all of) the triaxial material. Presently preferred dental resins are selected from the group consisting of acrylic resin, urethane resin and methyl-methacrylate resin. The presently most preferred resin is bis-GMA resin. The triaxial material preferably has a refractive index similar to, preferably identical to, that of the dental resin.

The triaxial material preferably includes fibers oriented in three different directions, wherein one of the directions is the direction of the long axis of the dental structure. More preferably, from about 33.3% to about 50% of the fibers are oriented

in the direction of said long axis. In a presently preferred embodiment, the present invention provides dental structures including more than one, successive layer of triaxial material, each of the successive layers being offset by a desired angle with respect to a preceding layer.

In another embodiment of the present invention, a stress-bearing beam framework, such as a dental bridge, is constructed from multiple layers of triaxial material and resin.

Detailed Description of the Preferred Embodiment

As used herein, the term "triaxial material" means a material having three sets of fibers oriented in three different directions. Preferably, the triaxial materials useful in the practice of the present invention are in the form of a braided ribbon or woven fabric.

As used herein, the term "resin" encompasses pure resins (such as acrylic resins, urethane and bisGMA resin) and dental, particulate, composite resins (including macrofils, microfils and hybrids).

As used herein, the term "dental structure" refers to natural structures, such as teeth, and synthetic structures, such as a dental bridge, that constitute, or are applied to, the dentition of an animal. Thus, for example, natural teeth, dental restorations, dental prostheses and dental appliances are all encompassed by the term "dental structure."

The present invention provides methods for constructing, reinforcing or modifying dental structures. The methods of the present invention include the step of contacting a dental structure with resin and a triaxial material. Preferably the triaxial material is in the form of a triaxial weave or fabric. In one embodiment of the methods of the present invention, one or more layers of a triaxial material is applied to a resin portion of a dental structure, the triaxial material is infused with a resin, and at least a portion of the triaxial material, preferably all of the triaxial material, is covered with more resin.

In another aspect, the present invention provides dental structures (such as a tooth) constructed, reinforced or modified with a triaxial material. FIGURE 1 shows a dental structure 10 including a filling 12 that includes a portion of triaxial material 14. In the example shown in FIGURE 1, dental structure 10 is a tooth. FIGURE 2 shows a cross section of dental structure 10 and filling 12. Filling 12 includes a layer of triaxial material 14 between a first dental resin layer 16 and a second dental resin

layer 18. First dental resin layer 16 mainly serves to bond filling 12 to dental structure 10.

The triaxial materials utilized in the practice of the present invention include three sets of intersecting fibers which are oriented, along their longitudinal axes, in three, different directions and which intersect at predetermined angles. The orientation of the three sets of fibers, and the angles of intersection between intersecting fibers, largely governs the ability of the triaxial material to resist deformation by one or more externally-applied forces. The three sets of fibers can each include more than one type of fiber mixed in various proportions depending on the desired properties of the triaxial material. Additionally, the proportion of fibers disposed in each of the three directions can be varied. Preferably the triaxial materials useful in the practice of the present invention will have from about 33.3% to about 50% of the total number of fibers disposed in the axial direction.

By way of non-limiting example, the fibers of the triaxial material can be natural fibers, such as silk; synthetic, organic fibers, such as nylon, polyester, polypropylene, aramids (such as Kevlar™), ultra high molecular weight polyethylene (such as Spectra™); and synthetic, inorganic fibers, such as glass, boron, carbon and silicon carbide. The presently preferred material from which the fibers of the triaxial material are synthesized is Spectra™. Kevlar™ is commercially available from DuPont, Wilmington, Delaware. Spectra™ is commercially available from Allied Signal, Petersburg, Virginia.

Triaxial materials useful in the practice of the present invention can be manufactured utilizing standard techniques well known to one of ordinary skill in the art. Prior to use, triaxial materials useful in the practice of the present invention can be cut from a bolt of cloth or preferably from a ribbon. By ribbon is meant a long and narrow piece of fabric. Preferably the triaxial material will be cut to a width of from about 1 millimeter (mm) to about 4 mm, and will have a thickness of about 0.2 mm. Preferably the triaxial material will have a denier value of from about 100 to about 215. The triaxial material can be used as is, or it may be provided and used in a form that is already impregnated with resin. The triaxial material may also be treated to promote adhesion with the resin. For example, a presently preferred material from which the triaxial material can be constructed is Spectra™ which is a high-strength, extended chain polyethylene. It is known that gas plasma treatment of Spectra™ fiber can result in epoxy composites which possess outstanding properties. Preferably, cold gas plasma is utilized to treat Spectra™ fiber. In general, the technique of gas plasma

treatment involves placing triaxial material within a reaction chamber, introducing process gas into the reaction chamber, and subjecting the process gas to a high energy discharge (such as an ultraviolet glow discharge) to generate process gas ions which abstract surface hydrogen atoms from the triaxial material and replace them with polar groups. The primary objective of this gas plasma treatment is surface modification, wherein hydrogen atoms are abstracted and replaced with polar groups (*e.g.*, hydroxyl, carboxyl and the like). The presence of polar or functional chemical groups on the surface of the fiber enhances wettability by and reactivity with a resin matrix, thus promoting excellent adhesion between the fiber and the resin. Individual fibers can be plasma-treated, but preferably triaxial material is subjected to plasma treatment.

Single as well as multiple layers of triaxial material are contemplated in connection with the present invention. When multiple layers of triaxial material are utilized, they may be exactly superimposed on each other, or each successive layer may be offset by a desired angle with respect to the preceding layer. A benefit of utilizing multiple, offset layers of triaxial material in a dental structure is that the completed dental structure can better resist shear forces applied from any angle. For example, FIGURE 3 shows a dental structure 10 including a first layer of triaxial material 20 superimposed upon a second layer of triaxial material 22, first triaxial material layer 20 being offset with respect to second triaxial material layer 22.

Preferably, triaxial materials useful in the practice of the present invention are translucent and have a refractive index that is similar, preferably identical, to that of the dental resin with which the triaxial material is impregnated in a dental structure.

Typically, the triaxial material incorporated into a dental structure will be covered with resin. While the resinous covering will generally be the same resin as the underlying resin layer, a different resinous covering could also be employed, as long as it exhibits sufficient adhesion both to the triaxial material and to the underlying resin.

To prepare the triaxial material for use, a portion of the triaxial material is cut to the desired size and shape. The triaxial material is preferably wetted with a low viscosity resin before it is impregnated with a more viscous resin. For example, before using an acrylic resin, the triaxial material is preferably wetted with the acrylic resin monomer, which serves as the thinning agent.

The amount of triaxial material used to reinforce a particular dental structure will depend upon the size and shape of the area to be reinforced and the direction of

the forces exerted upon the structure. Based on the conventional understanding and experience of those working in the field of dentistry it will typically be possible to predict in advance which portions of a given dental structure will need reinforcement.

In general, the greater the fiber volume proportion of triaxial material used to reinforce the dental structure, the greater will be the strength of the reinforced structure. Thus, one of ordinary skill in the art will be able to tailor the strength of a given dental structure by adding more or less of the triaxial material to the resinous portion of the structure.

All resinous dental structures can be constructed, reinforced or modified in accordance with the methods of the present invention. Specific examples of dental structures that can be constructed, reinforced or otherwise altered in accordance with the methods of the present invention include, but are not limited to: fillings, periodontal splints; directly bonded endodontic posts and cores; bonded orthodontic retainers; directly bonded bridges; immediate replacement of avulsed or extracted teeth; reinforcing long-term provisional bridges; denture and bridge repair; reinforcing over-denture components; reinforcing composite-resin restorations; reinforcing implant retained maxial facial prostheses.

Several layers of triaxial material can be utilized to construct a dental structure. For example, it is preferable to utilize several layers of triaxial material in the construction of a stress-bearing, beam framework such as a dental bridge. Some dental structures, such as a filling or a dental splint holding two teeth together, will preferably incorporate only a single layer of triaxial material. As is well known to one of ordinary skill in the art, some dental structures, such as a dental bridge, can be constructed either directly on the teeth or outside of the mouth and then applied to the teeth.

All resins used in dentistry can be utilized in the practice of the present invention. The basic requirements of the resin useful in the practice of the present invention are that it be compatible with a particular dental use and capable of sufficiently adhering to the triaxial material to result in a suitable reinforced dental structure. Generally, the resin will be a synthetic resin. Preferably the resin is an acrylic resin, such as bis-GMA resin, which is a standard resin familiar to dentists. The presently preferred resins are bis-GMA, methyl-methacrylate and urethane resins. Bis-GMA resins are commercially available from, for example, BISCO Dental Products, Itaska, Illinois, and DENTSPLY CAULK, Milford, Connecticut.

The following examples merely illustrate the best mode now contemplated for practicing the invention, but should not be construed to limit the invention.

EXAMPLE 1

Constructing a Splint Directly on the Teeth

The methods of the present invention can be used to construct a splint directly on teeth as described herein. A piece of triaxial material is cut to the desired dimensions. The teeth that are to be splinted are prepared in a standard manner by cleaning with pumice, acid-etching and applying unfilled bonding resin. If desired, a groove may be cut in the surface of the teeth. A layer of filled, composite resin is then applied to the prepared teeth.

The cut, triaxial material is wetted with unfilled bonding resin. The excess, unfilled bonding resin is blotted with lint-free gauze, and the triaxial material is applied to the composite on the teeth. The triaxial material is then conformed to the shape of the teeth to which it is applied, and excess resin is removed. The resin is then polymerized, for example by exposure to light. An additional layer of resin is applied over the triaxial material. Either a filled composite, or a moderately filled composite can be used. The resin is then polymerized and polished.

While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of constructing, reinforcing or modifying a dental structure comprising contacting said dental structure with dental resin and a triaxial material.

2. The method of Claim 1 wherein said resin is selected from the group consisting of acrylic resin, urethane resin and methyl-methacrylate resin.

3. The method of Claim 1 wherein said resin is bis-GMA resin.

4. The method of Claim 1 wherein said triaxial material is selected from the group consisting of triaxial braided fabric and triaxial woven fabric.

5. The method of Claim 1 wherein said triaxial material comprises fibers selected from the group consisting of silk, nylon, polyester, polypropylene, aramid, ultra high molecular weight polyethylene, glass, boron, carbon and silicon carbide.

6. The method of Claim 1 wherein said triaxial material comprises Kevlar™ fibers.

7. The method of Claim 1 wherein said triaxial material comprises Spectra™ fibers.

8. The method of Claim 7 wherein said Spectra™ is treated with gas plasma.

9. The method of Claim 8 wherein said Spectra™ is treated with cold gas plasma.

10. The method of Claim 1 wherein said dental structure is selected from the group consisting of fillings, periodontal splints, directly bonded endodontic posts, directly bonded endodontic cores, bonded orthodontic retainers, bridges, over-denture structures, composite-resin restorations, and implant retained maxial facial prostheses.

11. The method of Claim 1 further comprising the steps of:

(a) applying at least one layer of said triaxial material to a resin portion of a dental structure;

(b) infusing said triaxial material with resin; and

(c) covering at least a portion of said triaxial material with resin.

12. The method of Claim 1 wherein more than one, successive layer of said triaxial material are utilized, each of said successive layers being offset by a desired angle with respect to a preceding layer of triaxial material.

13. A dental structure comprising a triaxial material.

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14. The dental structure of Claim 13 wherein said triaxial material is selected from the group consisting of triaxial braided fabric and triaxial woven fabric.

15. The dental structure of Claim 13 wherein said triaxial material comprises fibers selected from the group consisting of silk, nylon, polyester, polypropylene, aramid, ultra high molecular weight polyethylene, glass, boron, carbon and silicon carbide.

16. The dental structure of Claim 13 wherein said triaxial material comprises Kevlar™ fibers.

17. The dental structure of Claim 13 wherein said triaxial material comprises Spectra™ fibers.

18. The dental structure of Claim 17 wherein said Spectra™ is gas plasma-treated Spectra™.

19. The dental structure of Claim 18 wherein said Spectra™ is cold gas plasma-treated Spectra™.

20. The dental structure of Claim 13 wherein said dental structure is selected from the group consisting of fillings, periodontal splints, directly bonded endodontic posts, directly bonded endodontic cores, bonded orthodontic retainers, bridges, over-denture structures, composite-resin restorations, and implant retained maxial facial prostheses.

21. The dental structure of Claim 13 further comprising dental resin.

22. The dental structure of Claim 21 wherein said dental resin is selected from the group consisting of acrylic resin, urethane resin and methyl-methacrylate resin.

23. The dental structure of Claim 21 wherein said dental resin is bis-GMA resin.

24. The dental structure of Claim 21 wherein said triaxial material is covered with dental resin.

25. The dental structure of Claim 13 further comprising more than one, successive layer of said triaxial material, each of said successive layers being offset by a desired angle with respect to a preceding layer.

26. The dental structure of Claim 21 wherein said triaxial material has a refractive index similar to that of said dental resin.

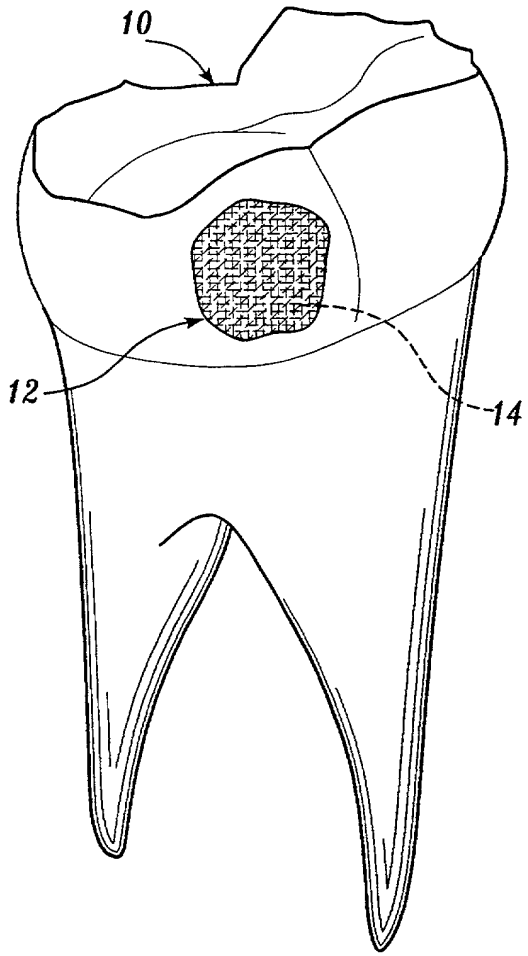

Fig. 1.

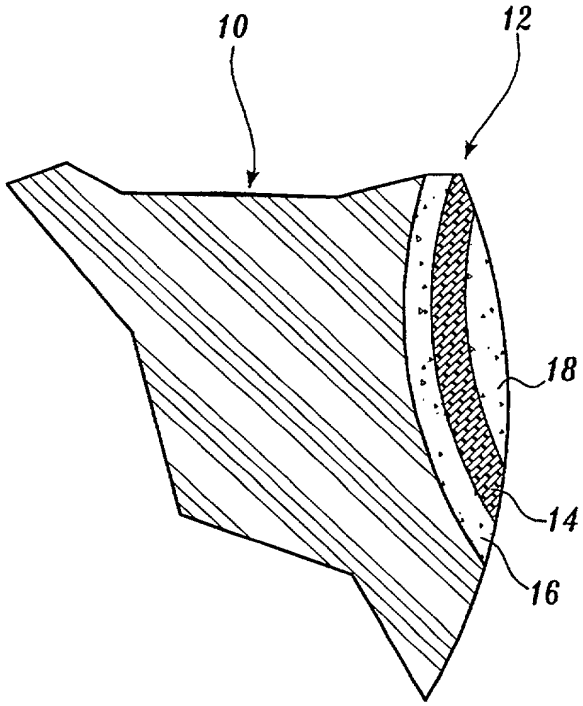

Fig. 2.

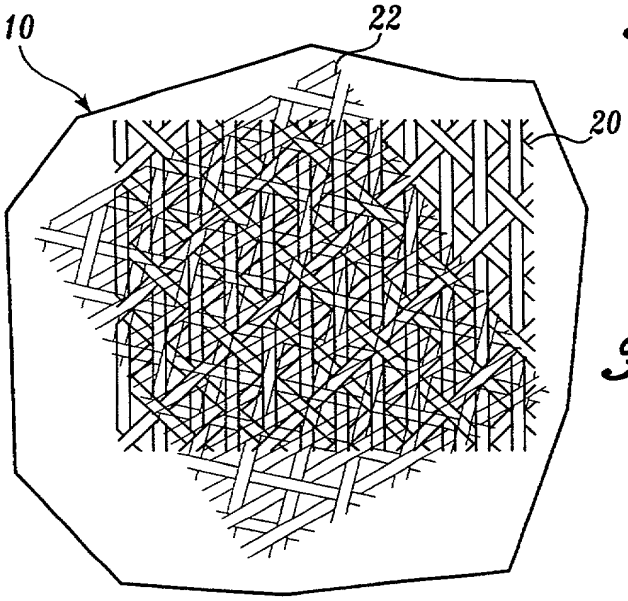

Fig. 3.

Attorney Docket No. RUDO117125

COMBINED DECLARATION AND POWER OF ATTORNEY
IN PATENT APPLICATION

As the below-named inventor, I hereby declare that:

my residence, post office address, and citizenship are as stated below next to my name;

I believe that I am the original, first, and sole inventor of the subject matter that is claimed and for which patent is sought on the invention entitled TRIAXIAL WEAVE FOR REINFORCING DENTAL RESINS, the specification of which was filed on October 8, 1999, as International Application No. PCT/US99/23563, as amended on August 28, 2000.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(c), of any foreign application(s) for patent listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed: NONE

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(d), of any inventor's certificate listed below. I declare that, upon investigation, I am satisfied that to the best of my knowledge, when filing the application for the inventor's certificate I had the option to file an application for either a patent or an inventor's certificate as to the subject matter of the identified claim or claims forming the basis for the claim of priority: NONE

I hereby claim the benefit under Title 35, United States Code, Section 119(e), of any United States provisional application(s) listed below:

Provisional Application:

Application No.	Filing Date
60/104,265	October 14, 1998

I hereby claim the benefit under Title 35, United States Code, Section 120, of any United States application(s) or PCT international application(s) designating the United States listed below:

Prior PCT Application:

Application No.	Filing Date	Status
PCT/US99/23563	October 8, 1999	Pending

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith: Bruce E. O'Connor, Reg. No. 24,849; Lee E. Johnson, Reg. No. 22,946; Gary S. Kindness, Reg. No. 22,178; James W. Anable, Reg. No. 26,827; James R. Uhlir, Reg. No. 25,096; Jerald E. Nagae, Reg. No. 29,418; Dennis K. Shelton, Reg. No. 26,997; Jeffrey M. Sakoi, Reg. No. 32,059; Ward Brown, Reg. No. 28,400; Robert J. Carlson, Reg. No. 35,472; Marcia S. Kelbon, Reg. No. 34,358; Rodney C. Tullett, Reg. No. 34,034; Daiva K. Tautvydas, Reg. No. 36,077; Mary L. Culic, Reg. No. 40,574; Julie C. VanDerZanden, Reg. No. 38,105; George E. Renzoni, Ph.D., Reg. No. 37,919; and Philip P. Mann, Reg. No. 30,960; and the firm of Christensen O'Connor Johnson Kindness^{PLLC}. Address all telephone calls to Barry F. McGurl at telephone No. 206.695.1775.

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I hereby further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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